

*Full Length Research Paper*

# Phytochemical and proximate composition of cucumber (*Cucumis sativus*) fruit from Nsukka, Nigeria

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**Cucumber (*Cucumis sativus* L.) is very common, cultivated throughout the world and often eaten as a raw vegetable without cooking. In this study, the phytochemical and proximate compositions of cucumber were investigated. Quantitative phytochemical analysis of the homogenate of *C. sativus* fruit showed that reducing sugars ( $574.36 \pm 3.88$  mg/g) was highest amount when compared to other phytochemicals, alkaloids ( $2.22 \pm 0.96$  mg/g) and flavonoids ( $2.14 \pm 0.56$  mg/g) were moderately present, while cyanogenic glycoside ( $0.21 \pm 0.13$  mg/g) was the lowest in quantity. Proximate analysis showed that *C. sativus* fruit contained the following - fibre ( $1.02 \pm 0.01\%$ ), moisture ( $94.2 \pm 0.08\%$ ), protein ( $3.01 \pm 0.07\%$ ), lipid ( $0.55 \pm 0.13\%$ ), carbohydrate ( $0.28 \pm 0.09\%$ ) and ash ( $0.94 \pm 0.24\%$ ) contents.**

**Key words:** Phytochemicals, *Cucumis sativus*, proximate constituents.

## INTRODUCTION

Phytochemicals are secondary metabolites produced by plants. These products are biologically active, naturally occurring chemicals in various parts of a plant, providing health benefits for humans further than those attributed to macronutrients and micronutrients. Their functions are diverse and include provision of strength to plants, attraction of insects for pollination and feeding, while some are simply waste products (Ibegbulem et al., 2003). They give plants colour, flavour, and smell and are part of plants' natural defence system, protecting plants' cells from environmental hazards such as pollution, stress, drought, UV exposure and pathogenic attacks (Ejele and Akujobi, 2011). These compounds have been linked to

human health by contributing to protection against degenerative diseases (Dandjesso et al., 2012). Phytochemicals are present in varieties of plants utilized as important components of both human and animal diets. These include fruits, seeds, herbs and vegetables (Okwu, 2005). Different mechanisms have been suggested for the action of phytochemicals. They may act as antioxidants, or modulate gene expression and signal transduction pathways (Dandjesso et al., 2012). Phytochemicals may be used as chemotherapeutic or chemopreventive agents (Paolo et al., 1991). They are formed during the plant normal metabolic processes. The medicinal values of a plant lie in its constituent phytochemicals, which produce

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the definite physiological actions on human body. The most important of these phytochemicals are alkaloids, tannins, flavonoids and phenolic compounds (Iwu, 2000).

Cucumber (*Cucumis sativus*) fruit is a widely cultivated plant in the gourd family of Cucurbitaceae, which also includes important crops such as melon, water melon and squash (Vivek et al., 2017). The plant has large leaves that form a canopy over the fruit. The fruit of the cucumber is roughly cylindrical, elongated with tapered ends, and may be as large as 60 cm (24 inches) long and 10 cm (3.9 inches) in diameter. Having an enclosed seed and developing from flowers, botanically speaking, cucumber can be classified as an accessory fruit (Huang et al., 2009). There is increased consumption of *C. sativus* fruits possibly because of their high nutritional value. The nutritional compositions of *C. sativus* include protein, fat and carbohydrate as primary metabolites; along with dietary fibre which is important for the digestive system. *C. sativus* contains some essential vitamins and anti-oxidants which are effective in human health (Grubben and Denton, 2004; Wang et al., 2007). *C. sativus* is used for jaundice, bleeding disorders and anuria; while its seeds are highly nourishing (Gogte, 2000). Till date, the present study on *C. sativus* represents variety of pharmacological activities like anticancer, anthelmintic, antimicrobial, hypolipidemic, antiulcer, analgesic and antioxidant (Dhande et al., 2013). It is believed that *C. sativus* seed has flavonoid, tannin, terpenoids and some phytochemicals (Kumar et al., 2010). Despite the acclaimed presence of those phytochemicals, to the best of our knowledge, the phytochemical and proximate compositions of the whole fruit (homogenate) is yet to be empirically established. Here, the phytochemical and proximate compositions, along with the potential pharmaceutical function of the whole *C. sativus* L. fruit were examined, highlighted and shown as homogenate.

## MATERIALS AND METHODS

### Plant material

Cucumber (*C. sativus*) fruits were purchased from Nsukka Main Market, Nsukka, Enugu State, Nigeria and were identified by Mr. Alfred Ozioko of Bioresources Development and Conservation Programme (BDCP) Research Centre, Nsukka, Enugu. The fruits were washed under running water, homogenized with Kenwood high speed blender and used for analysis without further dilution.

### Qualitative phytochemical analysis

The qualitative phytochemical analyses of the fruits of *C. sativus* were carried out according to the methods of Harborne (1998) and Trease and Evans (2002). Quantitative determination of tannin was conducted using spectrophotometric determination method described by Gupta and Verma (2010). The total phenol content of *C. sativus* fruit was determined using a spectrophotometric method of Wolfe et al. (2003). Cyanogenic glycoside was determined using alkaline picrate method as described by Harborne (1998).

Spectrophotometric determination of glycoside content was carried out with a method described by Quasheesh (1937). The flavonoid content was estimated using ferric chloride colorimetric method of Mattila and Kumpulainen (2002). Saponin content was quantitatively estimated by spectrometric determination method of Uematsu et al. (2000). Determination of alkaloid content was carried out by the method described by Harborne (1998). The amount of steroid was determined by the method described by Edeoga et al. (2005). Quantitative determination of reducing sugars was carried out using Folin and Wu method (1920). Resin content was determined quantitatively by the UV absorption method of Harborne (1998). Quantitative estimation of terpenoid content was carried out using oxidation method of Harborne (1998). Anthocyanin content was estimated quantitatively with pH differentiation method of Harborne (1998). Chlorophyll content was determined using Harborne (1998) method.

$$\text{Chlorophyll b } \left( \frac{\text{mg}}{\text{g}} \right) = \frac{(19.3 \times \text{Absorbance @ 645}) - 3.6 \times (\text{Absorbance @ 663})}{1000 \times W} \times V$$

$$\text{Chlorophyll a } \left( \frac{\text{mg}}{\text{g}} \right) = \frac{(12.3 \times \text{Absorbance @ 663}) - 0.86 \times (\text{Absorbance @ 645})}{1000 \times W} \times V$$

Where, V = Volume of solvent, and W = Weight of homogenate.

### Proximate analysis

The proximate analysis of the homogenate of *C. sativus* fruits for moisture, ash, fat and carbohydrate were determined as described by AOAC (2000). The concentration of crude protein and fibre were determined using methods described by Pearson (1976). All determinations were done in triplicates and the results were expressed as means of percent values on dry weight basis.

### Statistical analysis

Each experiment was repeated three times, and the results were presented as means and standard deviation.

## RESULTS AND DISCUSSION

As shown in Table 1, bioactive compounds such as steroids, terpenoids, glycosides and resins were found in relatively high concentrations; saponins, alkaloids and flavonoids were present in moderate concentrations, while tannins were slightly present. Table 2 shows quantitatively, the phytochemical composition of *C. sativus* fruit homogenate. Bioactive compounds such as reducing sugars were found to be in highest amount ( $574 \pm 3.88$  mg/g) relatively compared to other phytochemicals as shown in Table 2. Alkaloids and flavonoids that were moderately present were found in the concentration range of  $2.22 \pm 0.96$  and  $2.14 \pm 0.56$  mg/g respectively. The concentration range of cyanogenic glycosides:  $0.21 \pm 0.13$  mg/g was very low. The proximate analyses of the homogenate of *C. sativus* fruit showed the presence of moisture, crude protein, ash and crude fibre with values shown in Table 3. The homogenate of *C. sativus* fruit had high concentrations of moisture ( $94.6 \pm 0.08\%$ ).

**Table 1.** Qualitative phytochemical constituents of the homogenate of *Cucumis sativus* fruit.

Phytochemical	Relative presence
Alkaloids	++
Glycosides	+++
Steroids	+++
Saponins	++
Tannins	+
Flavonoids	++
Terpenoids	+++
Resins	+++

+ = Slightly present; ++ = moderately present; +++ = highly present.

**Table 2.** Quantitative phytochemical constituents of the homogenate of *Cucumis sativus* fruit.

Phytochemicals	Composition (mg/g)
Tannins	1.26 ± 0.07
Polyphenols	8.51 ± 0.50
Phenols	7.72 ± 0.50
Cyanogenic glycosides	0.21 ± 0.13
Anthocyanins	1.21 ± 0.39
Glycosides	32.23 ± 0.41
Reducing sugars	574.36 ± 3.88
Saponins	2.01 ± 0.08
Alkaloids	2.22 ± 0.96
Flavonoids	2.14 ± 0.56
Terpenoids	26.27 ± 1.37
Steroids	11.69 ± 1.80
Resins	50.70 ± 8.82
Chlorophyll a	4.49 ± 0.03
Chlorophyll b	12.09 ± 0.04

Values indicate Mean ± SD (n = 3).

Proximate analyses also revealed ash as being very low (1.07 ± 0.24%).

This study reveals the presence of phytochemicals considered as active medicinal chemical constituents. Important medicinal phytochemicals such as terpenoids, reducing sugar, glycosides, resins, flavonoids, alkaloids, phenols, saponins, steroids and tannins were present in the homogenate of cucumber fruits (Table 1). Bioactive compounds such as reducing sugars were found to be in highest amount (574 ± 3.88 mg/g) relatively compared to other phytochemicals as shown in Table 2. Alkaloids and flavonoids that were moderately present were found in the concentration range of 2.22 ± 0.96 and 2.14 ± 0.56 mg/g, respectively. The concentration range of cyanogenic glycosides (0.21 ± 0.13 mg/g) was very low. The presence of flavonoids in cucumber fruit homogenate suggests that the fruit homogenate has the ability to

**Table 3.** Proximate composition of the homogenate of *Cucumis sativus* fruit.

Constituent	Percentage
Moisture	94.2 ± 0.08
Crude protein	3.01 ± 0.07
Crude fibre	1.02 ± 0.01
Ash	0.94 ± 0.24
Lipid	0.55 ± 0.13
Carbohydrate	0.28 ± 0.09

Values indicate mean percentage ± SD (n = 3).

scavenge free radicals as they are the chief sources of antioxidant (Singh Gill et al., 2010; Egbung et al., 2013) in plants which have been known to play some role in free radical scavenging. The antioxidant activity of the phenolics, tannins, flavonoid compounds are attributed to their redox properties which can act as reducing agents, hydrogen donors and singlet oxygen quenchers (Gulcin et al., 2007; Andreia et al., 2013). Polyphenolics having hydroxyl groups are very important plant constituents which can protect the body from different types of oxidative stress (Jing et al., 2010; Anoop and Bindu, 2015) such as CCl<sub>4</sub> induced hepatotoxicity. Epidemiologic studies recommend that coronary heart disease is opposed by dietary flavonoids (Wadood et al., 2013). Saponins detected in the fruit, is a known anti-nutritional factor, which reduces the uptake of certain nutrients including glucose and cholesterol at the gut through intra-luminal physiochemical interactions (Shi et al., 2004; Agbafor et al., 2015). It has been reported to have hypocholesterolemic effects; hence it is useful in human diet in controlling cholesterol levels (James et al., 2010) and may aid in lessening the metabolic burden that would have been placed on the liver during metabolism. The homogenate of *C. sativus* fruits show trace amount of tannins which have been reported to possess some medicinal properties (Ekeanyanwu et al., 2010). Its wound healing properties, which include anti-inflammatory, analgesic (Ayinde et al., 2007) and antioxidant properties (Okwu and Okwu, 2004) have been reported; although they (tannins) are anti-nutrients (Doss et al., 2011). Ibrahim et al. (2014) reported anti-microbial effects of tannins through membrane disruption, binding to proteins, adhesions and enzyme inhibition. This result is in line with the findings of Liener (1994) who stated that lower concentrations of tannins in plants are found to be desirable for human and animal consumption. It could be the reduced amounts of tannins in the homogenate of the fruit that enhanced the protective property rather than the side effects. The phytochemical screening result of this study is contrary to the report of Jony and Roksana (2012) who reported the absence of flavonoids in the ethanol extract of *C. sativus*. Perhaps also, flavonoids were not detected as a result of the

extraction method used, as Kumar et al. (2010) reported the presence of flavonoids in the aqueous extract, thus correlating the findings of this investigation. The homogenate of *C. sativus* fruit also revealed the presence of significant amount of chlorophylls a and b. Chlorophyll is important in many plant metabolic functions such as growth and respiration. It is used in medicinal preparation for treating anaemia and hypertension as a healing agent and in oral hygiene (Fischman, 1997; Mujoriya and Bodla, 2012), indicating that *C. sativus* can be used to reduce bad breath and as healing agent.

The homogenate of *C. sativus* fruit also revealed the presence of alkaloids. Plants having alkaloids are used in medicines for reducing headache and fever. These are attributed to their antibacterial and analgesic properties (Pietta, 2000; Sotiroudou et al., 2010). Alkaloids have been reported to act as central nervous system stimulant (Abubakar et al., 2015). Also, they possess antispasmodic, antifungal, anti-fibrogenic effects (Ibraheem and Maimoko, 2014). Terpenoids detected in the fruit are reported to have anti-inflammatory (Olorunju et al., 2012), anti-viral, anti-malarial, inhibition of cholesterol synthesis (Njagi et al., 2015) and anti-bacterial properties (Wadood et al., 2013). The significant amount of terpenoids and alkaloids from this study show that *C. sativus* fruit homogenate could be recommended as an effective source of anti-bacterial agent. The proximate analyses show that the homogenate of *C. sativus* fruits have high concentration of moisture and relative amount of fibre, crude protein, ash, lipid and carbohydrate. Dietary fibre helps to reduce the chance of gastro intestinal problems such as constipation and diarrhoea by increasing the weight, size and wetness of stool (Weickert and Pfeiffer, 2008; Aina et al., 2012). Plant fibres are long chain carbohydrates (polysaccharides) that are indigestible by the digestive enzymes of human gastro intestinal tract (GIT). They help to keep the digestive system healthy and also aid and speed up the excretion of waste materials from the body (Weickert and Pfeiffer, 2008). The recommended daily allowance of fibre for a healthy adult is 20-25 g/day (American Dietetic Association, 2005). The result of this study is in line with the report that *C. sativus* is useful in fighting constipation, as the fibre content helps to overcome the hypotonic which aids constipation (Yohanna, 2013). The low concentration of lipid obtained for the fruit homogenate suggests that its regular incorporation and consumption in the diet is healthy for people on low fat diet. The result on the high concentration of moisture agrees with the report of Aina et al. (2012) that fleshy fruits have high percentage of moisture which aids in digestion and acts as a solvent in chemical reactions in the body system. The high moisture concentration is in accordance with the report of Egan et al. (1981) and Okoye (2013) which showed the moisture content of *C. sativus* as 96.4 and 97.8%, respectively. The appreciable amount of ash recorded from the study (Table 3) shows that *C. sativus* fruit homogenate could

be recommended as effective sources of mineral nutrients.

## Conclusion

Cucumber (*C. sativus*) fruit is a source of the secondary metabolites, that is, alkaloids, flavonoids, terpenoids, tannins, saponins, steroids, phenols, glycosides, reducing sugars, etc. Cucumber fruit may play vital role in preventing various diseases such as inflammation, bacterial infection, lipid peroxidation, fever, constipation, etc. The anti-inflammatory, anti-bacterial, antioxidant, analgesic and anti-constipation may be due to the presence of the above mentioned phytochemicals especially flavonoid ( $2.14 \pm 0.56$  mg/g), alkaloids ( $2.22 \pm 0.96$  mg/g) and proximate constituents. Thus, it is expected that the important phytochemical properties and proximate compositions identified in this study in the homogenate of cucumber fruit will be helpful in the coping of different diseases.

## CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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